

# Anthropometric Design

**Anthropometric Design is an approach to be used through the design process to ensure the optimal fit of products to the people using them. Doing so will help you to design and make decisions on adjustability, size, and shape throughout the design process.**

**WHAT & WHY?** The interior of a car, a train seat, an office chair, safety equipment, or a hand tool, should accommodate the variation in shape and size of the targeted users. As the average user in terms of size, weight and shape doesn't exist, designers need to gain insight into the variation within their target group with the help of statistical measures such as percentiles and correlations between different body measurements.

Using scientific databases that include anthropometric information requires demographics about the users, such as birthday, age, and gender, because human size, weight, and shape widely vary across populations. You also need to determine which anthropometric parameters are relevant for the design at hand. Therefore, you need to study the interaction between the human body and the product and describe how users will handle the product, in what postures, and which movements they possibly will make.

**MINDSET:** Be aware of your user group and be aware of who will be excluded by certain design decisions. Children are very different from adults and so are people who are disabled in any type or form. An important principle is to always aim to design for all within your user group; to practice inclusive design. On the other hand, a personalised design or a design made for a very limited user group might prove to be useful for a larger group of users. For example, an easy-to-open jar lid that is specifically designed for the elderly is easy to open for all. Such a well thought-out design strategy facilitates the comfortable, safe, and efficient use of products.

**WHEN?** Anthropometric data can be used in different stages of the design process, preferably right from the discovery phase because this ensures an optimal outcome, instead of trying to adjust the design at the end of the design process.

**HOW?** First the future user group is defined. Then decide whether a product should be one-size-fits-all, have a size system, be made adjustable, or be fully personalised. Depending if the additional costs and complexity are worth the gain in ergonomics. The method involves 5 steps:

**Step 1:** Define the target population, taking into account demographic variables as well as relevant abilities and disabilities. Describe the context of use: posture, movements, and sequence of movements; socio-cultural influences; artefacts (clothing, tools, equipment) and physical environment. Observing how similar products are used can be very helpful in this stage.

**Step 2:** Search for anthropometric data, for example, in the DINED database (dined.nl) or scientific papers. Consider representativeness (demographic variables), precision, and presentation type (1D, 2D, 3D). If no data are available, determine whether there is time and budget to perform

measurements for the missing data; otherwise, make estimations (based on the correlation between known variables).

**Step 3:** When all the data have been collected, add allowances for worn garments and use of tools and equipment. For example, stature +20mm for shoe sole thickness.

**Step 4:** Establish the anthropometric design guidelines. Prototypes are needed to evaluate the fit, comfort, force exertion, interaction during short use or prolonged use, and interaction with the environment while using the tool.

**Step 5:** The use of statistics and databases is a simplification of the reality; the proper evaluation of the final concept based on a mock-up is necessary. This process is often iterative, and a fifth step to search for additional anthropometric data could be necessary.

**REFERENCES & FURTHER READING:** Jellema, A., Galloin, E., Massé, B., Ruiter, I., Molenbroek, J., & Huysmans, T., 2019, *3D Anthropometry In Ergonomic Product Design Education*. In I. Whitfield (Ed.), In proceedings of the 21th International Conference on Engineering and Product Design Education, Glasgow. / Lee, W., Molenbroek, J., Goto, L., Jellema, A., Song, Y., & Goossens, R., 2019. *Application of 3D scanning in design education*. In S. Scataglini, & G. Paul (Eds.), *DHM and Posturography*, (1st ed., pp. 721-731). Academic Press. / Robinette, K. & Hudson, J., 2006. *Anthropometry*. In G. Salvendy (Ed), *Handbook of Human Factors and Ergonomics* (3rd ed, pp. 322-339). John Wiley & Sons, Inc. / Verwulgen, S., Lacko, D., Vleugels, J., Vaes, K., Danckaers, F., De Bruyne, G., & Huysmans, T., 2018. A new data structure and workflow for using 3D anthropometry in the design of wearable products. *International Journal of Industrial Ergonomics*, 64, pp. 108-117.

**TIPS & CONCERNS**

It is important to mention that the size, weight, and shape of the population in the world is continuously changing (secular trends) due to ageing, lack of nutrition, overeating, or sedentary lifestyle.

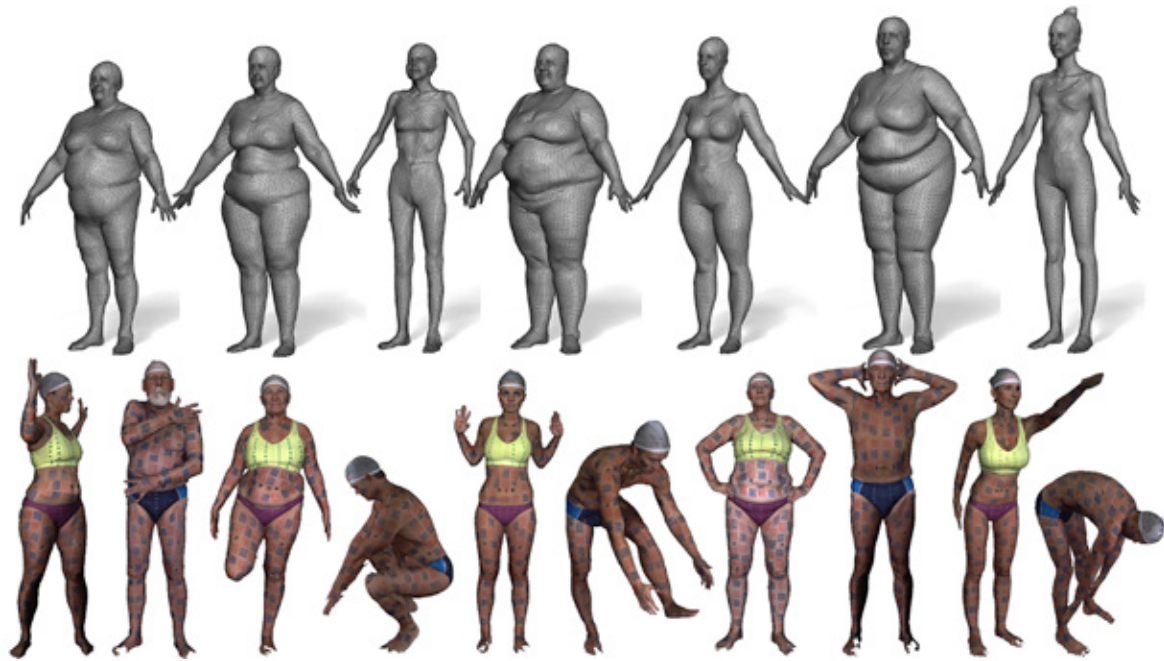
**Why not design for P0.1-P99.9?** The standard use of P5-P95 to define your target group will lead to the exclusion of 10% of the population per anthropometric variable.

The closer the product needs to fit on the body, the more important the knowledge about shape becomes. 3D scan data can be of great help.

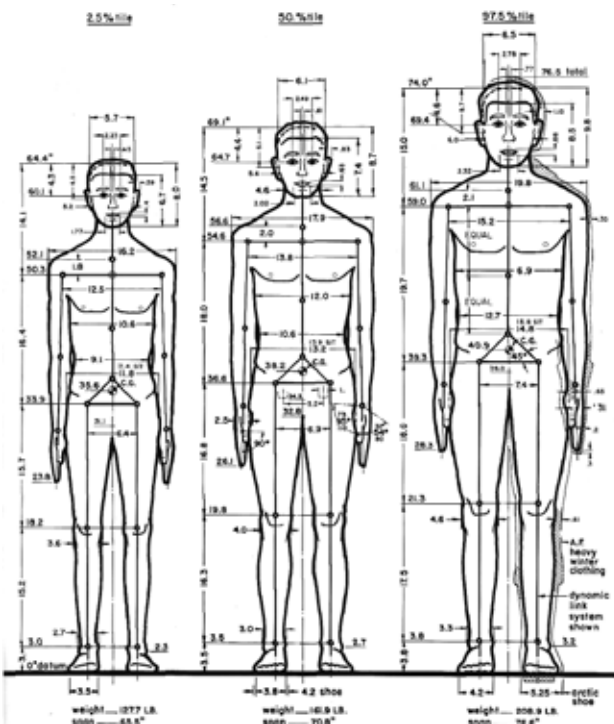
Some industries have developed advanced software representations of humans (Digital Human Models).

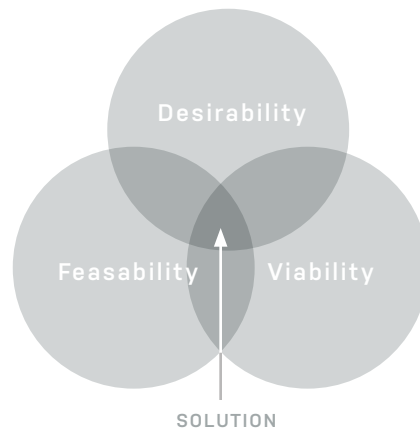
**LIMITATIONS**

Many modern products and systems integrate both physical and non-physical elements such as services and digital interfaces, for which additional data are needed.



The myth of designing for the 'average' person - since there are no people whose body dimensions are all at the 50th percentile. Body dimensions aren't linearly correlated so people with short arms don't necessarily have short legs. While the use of the 5th and 95th percentiles on one body dimension may exclude 10% of the population, the use of these on 13 dimensions actually can exclude 52% of the population.





A 'basted fitting' is when you try on a custom suit jacket that has been temporarily stitched together with white basting thread. Initial measurements that were carefully taken during your first fitting were used to create this 'working' jacket. This jacket is used to finetune the fitting. The basted fitting is also the customers first opportunity to try on the custom made suit. It may not look like much, but it will still feel like it was made for you.

## APPROACHES

# User-Centred Design

**User-Centred Design (UCD) is a design approach that focuses on the user perspective to create valuable and usable products, interfaces, services, or systems.**

**WHAT & WHY?** UCD is a problem-solving approach that focuses on the needs, desires, properties, and capabilities of projected users of a product, service, or system. This is contrary to taking technological possibilities or business considerations as a starting point. A UCD process is believed to positively influence the level of usability and the quality of the user experience.

UCD helps designers to predict what aspects of the design might be problematic for future users. At the start of a project designers know little about their users' needs, workflows, and limitations. On the other hand, designers typically know too much, because they are overly familiar with their own life and work. This makes it hard for designers to predict what aspects of the design might be problematic for future users.

Base your design on evidence from sources such as user observations, interviews, and data. Avoid assumptions and personal views and accept the fact that you might be wrong.

**MINDSET:** Listening to users and observing what they do is not the same as blindly doing what they say. You need a determined attitude with perseverance. Be prepared to see that your initial ideas, assumptions and preliminary designs might be off the mark, and always strive to evaluate them with projected users. Front-end user research and user evaluations require investments, and so does making design choices that result in better products.

**WHEN?** UCD is relevant in any domain where there is a gap between designer and user. The approach can be used throughout the design process, both for setting the design goals as well as for the creation of the design.

**HOW?** UCD is about learning from the active involvement of participants that represent the projected user group. User involvement is performed from the start to prevent taking important design decisions without knowing the user perspective. When it is not possible to include users, the user perspective can be sought through user representation methods (also called analytical or inspection methods). There are multiple models of UCD, which share the following types of activities that can be linked to the Basic Design Cycle.

**Step 1 - Front-end user research:** Know the user group, their needs, capabilities, and the context of use. (Interviews, Focus Groups, User Observations, Contextmapping, Cultural Probes, Questionnaires, Usage Analytics, Anthropometric Design)

**Step 2 - Define:** Set goals, requirements, and

limitations; describe user group and context of use. (Problem Definition, Persona, Cultura, List of Requirements)

**Step 3 - Create:** Synthesize a solution that incorporates knowledge from users and capture a new, desired state. (Storyboarding, Design Drawing to Develop, Journey Mapping)

**Step 4 - Prototype:** Create simulations that allow participants to experience the future product, service, or system. (Written Scenario, Storyboarding, Three Dimensional Physical Model, Experience Prototyping, Cinematic Prototyping, Wizard of Oz)

**Step 5 - Evaluate use:** Assess the use and user experience of the design through user involvement and/or representation. (Product Concept Evaluation, Product Usability Evaluation (lab or field), Focus groups).

**REFERENCES & FURTHER READING:** ISO. 2010. ISO 9241 Ergonomics of human-system interaction. In: Part 210: Human-centred design for interactive systems (formerly known as 13407). Switzerland: International Organization for Standardization. / Nielsen, J., 1992. The usability engineering life cycle. *IEEE Computer*, 25(3), 12-22. / Norman, D., 2013. *The design of everyday things*: Revised and expanded edition. Basic books. / Van Kuijk, 2010. *Recommendations for usability in practice* (card set). Delft: Delft University of Technology.

**TIPS & CONCERNS**  
Use appropriate ways to involve participants in every phase of the design process.

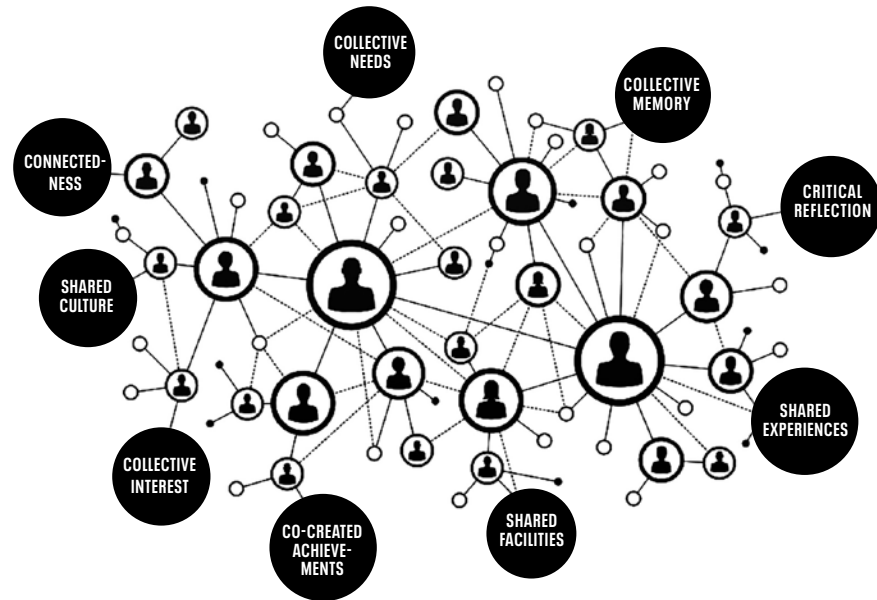
Realise that people are not only users but often also owners, observers, buyers, and so on.

Compared to UCD, Human-centred design has a more holistic perspective.

The overlap between the two approaches, in terms of methods applied and the required attitude, is considerable.

In many situations the experience of products and systems is a critical issue, which requires attention in its own right.

**LIMITATIONS**  
There is no guarantee that by going through the specified steps, a design will be usable or will have an excellent user experience, since in addition to the process, UCD is also very much about having a user-centred mindset throughout decision-making.



When people think of a refugee camp they imagine a collection of tents, hastily erected and soon to be removed. Few refugee camps conform to this image and develop into permanent settlements. The Concrete Tent designed by The Decolonizing Architecture Art Residency (DAAR) is a gathering space for communal learning. The urgency and idea of a space for cultural activities and social meetings emerged as a possibility to materialize and give architectural form to narrations and representations of camps and refugees beyond the idea of poverty, marginalization and victimisation. ([www.decolonizing.ps](http://www.decolonizing.ps))



## APPROACHES

# Co-Design & Co-Creation

The terms **Co-design** and **Co-creation** refer to a collaborative design effort where designers work with users, experts, or other non-designers in doing design activities together. The degree and amount of this can vary; it could be done in certain parts or all parts of the design process, depending on the availability and need.

**WHAT & WHY?** In design, you may find yourself working on problems that test your limits: You may not have enough knowledge about the problem or enough ability to create solutions, or you may find it difficult to influence the organisations involved. Collaborate with others, including stakeholders, to tackle this. When this collaboration goes beyond asking for input and becomes a process of working together creatively, we speak of Co-design or Co-creation. By involving others into the design activities, they become actors in the creative process. In this way, they can bring unexpected insights and ideas for solutions.

There are three reasons to involve users or other stakeholders. The first is an ethical reason since users and stakeholders will be affected by the solution. They should have a say about the design and what it becomes. Secondly, when users express their needs and abilities, they can provide designers the knowledge to make a better solution. Finally, the stakeholders need to gain support from relevant parties.

**MINDSET:** Co-design and Co-creation require your respect for each participant as a source of meaningful active contribution. As facilitator, you are responsible for supporting and managing the process. To do this, you will need to set up activities so that participants can bring their contributions despite the fact that they are not trained designers.

**WHEN?** Co-design and Co-creation can be used in different phases of the design process. You can use this when you do not know the user's life situation (referred to as co-design with intended users), when you want to include a combination of new technologies (co-design with experts), or when you want other people in the company to own the resulting insights so that they can work further on it (co-design with colleagues).

**HOW?** There are many ways to carry out Co-design and Co-creation. You can involve your collaborators throughout the design process, or you can use only one Co-creation session. You can engage with them in a one-on-one setting, in a group

session, or through social media. The key challenge is to equip participants with the language, tools, and the design topic – all of which should be adapted to support them in bringing in their expertise (see 'Context-mapping').

**REFERENCES & FURTHER READING:** van Doorn, F. A. P., Gielen, M. A. & Stappers, P. J., 2014. Involving children and elderly in the development of new design concepts to become active together. *Interaction Design and Architecture (s)*, 2014(21). / van Rijn, H., & Stappers, P. J., 2008. *Expressions of ownership: motivating users in a co-design process*. In Proceedings of the Tenth Anniversary Conference on Participatory Design 2008 (pp. 178-181). Indiana University. / Sanders, E. B. N. & Stappers, P. J., 2008. Co-creation and the new landscapes of design. *Co-design*, 4(1), 5-18. / Sanders, E.B.-N. & Stappers P.J. (2012) *Convivial Toolbox: Generative research for the front end of design*. Amsterdam: BIS Publishers.

### TIPS & CONCERNS:

Have a clear idea about what you want to achieve in your project and what the contribution of the participants can be.

Be open to unexpected contributions, but set the activity in a clear direction.

Manage the expectations of participants who may think they only have to provide their opinion about something you have made. Or you giving them your opinion or permission.

Ask participants to bring a creative contribution and connect their thinking to that of others.

Think of what could be an appropriate reward for them. This may be payment or the fact that the event is pleasant for them – it can even be fun!

A checklist for preparation includes: support from higher management; materials; an introduction; instructions; a script for the interaction; an agreement form if you want to record a session.

Use Co-Design for collaboration with users throughout the design process and Co-Creation for single session collaboration with experts within an organisation, as in focus groups.

### LIMITATIONS:

Organising participation can be a lot of work, and this requires time and budget, especially if it involves a large group of people.

It is often difficult to get hold of experts in busy professions and people with busy lives, but they can bring important input.